

The work includes chapters on the biology and ethnology of Russia, as well as of the remarkable faunal history of the Black Sea; it gives a short but interesting discussion of the density of the population, illustrated by a map, which would have been more readily useful if the index of shading had given reference to another measurement as well as to square-versts. The book concludes with two long and instructive sections on the economic geography and on the towns which will be of great service to those who cannot use the detailed information in the forty-one volumes of the great Russian Encyclopædia (*Entsikhlopedicheski Slovar*, 1890-1904).

LOCOMOTIVE ENGINEERING.

Locomotive Performance. By William F. M. Goss. Pp. xvi+439. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1907.) Price 21s. net.

The Railway Locomotive. What it is and why it is what it is. By Vaughan Pendred. Pp. xi+310. (London: A. Constable and Co., Ltd., 1908.) Price 6s. net.

PROF. GOSS and his assistants in the engineering laboratory of the Purdue University are to be congratulated on the very able manner in which they have carried out their researches on the performance of locomotives, and more particularly the experiments with the two locomotives installed in the locomotive testing plant at Purdue University.

The present volume is an account of the growth of the engineering laboratories at Purdue, the locomotive testing plant being more particularly dealt with, its inception being largely due to the interest taken by the late President Smart, of that university, in conjunction with the late A. J. Pitkin while general superintendent of the Schenectady Locomotive Works. In fact, the success of the laboratory appears to be largely due to the cooperation of the university authorities with the famous locomotive builders at Schenectady, many mechanical engineers being also interested in the success of the laboratory and rendering valuable assistance in many ways. As locomotive engineers, as a rule, base their designs on the result of practice and experience rather than on theoretical considerations, the contents of this volume must be of much interest to them, and we can strongly recommend its careful study.

The contents of the book are divided into five headings, the first four chapters dealing with "locomotive testing," under heading No. 1. These are most interesting, since the inception of the testing plant is described and the many difficulties discussed, the development of the laboratory largely increasing the interest taken by American locomotive engineers in the scientific treatment of the subject.

Chapter v. comes under heading No. 2, and gives a typical exhibit of the performance of a locomotive under varying conditions of speed and cut-off. Fig. 62 is an interesting illustration of the influence of speed on the indicator diagram when running with a late cut-off, making it very evident that both must

be considered as having an important influence on the mean effective pressure.

Chapter vi. in part iii. deals with boiler performance, a most interesting subject. The question of locomotive boiler design has come prominently to the front in recent years, and much attention has been given to it. The human factor, however, in the form of the fireman, enters very largely into the question, a fact which our author very carefully points out. Another most important detail of locomotive design is dealt with in chapter xi.; we refer to the smoke-box, or front end, since the efficiency of the engine is very largely due to the correct proportions and arrangement of the blast-pipe and chimney. The arrangement of these details is thoroughly discussed, and the best proportions expressed in simple equations.

Part iv. of the book deals very largely with cylinders, valve gear, and the all-important question of correct balancing. Prof. Goss is to be congratulated on the able way in which he has handled the latter subject; his experimental work as described in chapter xviii. is most valuable, and has added considerably to our knowledge.

Locomotive performance is discussed in part v. of this interesting book, the last chapter of which generalises the many points discussed. Taken as a whole, the volume is quite unique; it contains valuable information of a highly scientific nature, and we strongly recommend all interested in locomotive engineering to study it.

"The Railway Locomotive," by Mr. Vaughan Pendred, is a book very different from Prof. Goss's; it is one of the Westminster Series, and we are told that it is intended to bridge over the gaps left by specialisation. What this means is not quite clear; but if it is the intention of our author to describe the locomotive as it is for the benefit of engineers not of the locomotive variety, then he is to be congratulated upon having produced an interesting and useful volume, and one likely to fulfil the object he has in view.

The book is divided into three sections. The locomotive as a vehicle is first treated, and occupies nine chapters, the eighth of which deals with adhesion, and we are pleased to notice that the late Mr. Patrick Stirling's famous "singles" are quoted and referred to as highly successful engines. They will be remembered when many modern monstrosities have gone to the scrap-heap and been forgotten.

Section ii. deals with the boiler, the sectional diagram of which, Fig. 39, is certainly not modern. The author has much to say, naturally, about staying flat surfaces, and the differences in the coefficients of expansion of the copper fire-boxes in the steel shells of locomotive boilers. He here deals with the biggest worries of the locomotive engineer. Locomotive boilers have increased in dimensions in an abnormal manner, and, unfortunately, the bigger the boiler the bigger the wear and tear. Stay bolts are dealt with in chapter xii., and, passing over what the author has to say about Captain Palliser and armour plating, which has nothing to do with the case, we learn that various bronzes have been tried, as well as

Bowling and Low Moor iron. Copper is, of course, the universal practice for stay bolts when a copper fire-box is used. A copper stay bolt screwed into a copper plate with its head carefully riveted over is more likely to stand the wear and tear, since the coefficient of expansion is the same. Leakage at the joints is reduced to a minimum; the action of the fire on the riveted head is far less severe, thus ensuring a far longer life than if the stay was made of a bronze, which naturally wastes with the fire action, the head vanishing, and later on the shank of the stay bolt in the copper plate for the same reason unless replaced in time. Fig. 44 is a good illustration of this wear and tear, although it is probably intended to illustrate a badly worn copper stay many years old.

Given a wider water space, and a pitch of stay bolts less than the usual practice, then with the high pressures now in use no trouble need be anticipated from broken stays, and copper is evidently the proper material to use, since it has to be fitted into a copper plate and both exposed to intense heat.

On the general design of boilers we find much useful information, and reference is made to Mr. Drummond's water-tube fire-box; surely the late Mr. W. M. Smith, of the North-Eastern Railway, had a good deal to do with the arrangement of the water tube, it being originally fitted into the fire-box of North-Eastern Railway engine No. 1619 in a somewhat similar fashion. This engine is not mentioned, by the way, in chapter xxxiii., dealing with compound locomotives, although it is the progenitor of the Smith type of three-cylinder compounds on the Midland and Great Central Railways; that is to say, the engine is fitted with one high-pressure and two low-pressure cylinders, the latter being used as high-pressure cylinders and the former being in equilibrium when starting a heavy train automatically. It is, of course, well known that the three-cylinder Smith compounds on the Midland have been fitted with a special regulator valve, which does away with the Smith automatic valve.

The question of compound working of locomotives has been a prominent one for a long time, and we cannot congratulate the author on the way in which he has dealt with it; surely four pages in a book of 300 pages is a ridiculous proportion to give us in a work on the railway locomotive. All engineers are fully aware that Mr. T. W. Worsdell was the inventor of the two-cylinder compound locomotive; why Mr. James Worsdell should get the credit is a mystery. This is a careless mistake for which there is no excuse.

On the question of valve gear, expansion and link motion, we find much information, but why "James Stirling's" steam reversing gear is described as "Wainwright's" might be explained; besides this, the latest type of the Smith piston valve is not illustrated in Fig. 81. It is of the segmented type, and is intended to free the cylinder of water when necessary, being collapsible. The vacuum-destroying valve referred to has also been re-designed so far as to constitute a lubricator as well, thus lubricating the moving parts when running down hill with steam off, a much desired improvement.

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We have much pleasure in noticing these two books; they have been written from such different points of view that one forms the corollary of the other. Locomotive engineers will do well to find a place for both in their libraries.

OUR BOOK SHELF.

Feste Lösungen und Isomorphismus. By Dr. Giuseppe Bruni. Pp. vi+130. (Leipzig: Akademische Verlagsgesellschaft, 1908.) Price 4 marks.

As an authority on the subject of solid solutions Dr. Bruni has an international reputation, and it must be considered a fortunate circumstance that the Chemical Society of Breslau should have invited the author to give a special lecture to its members, for it is to that incident that the book before us owes its origin.

The theory of solid solutions put forward by van 't Hoff in 1890 represents an extension of his well-known theory of liquid solutions to the solid state of aggregation. As a means of interpreting the vast number of experimental observations which have been accumulated since the date of its conception, van 't Hoff's theory has been invaluable. The author is one of its staunchest adherents, and has himself done much to uphold the theory in the face of adverse criticism.

Dr. Bruni has retained the original form of the address in the published text. The subject-matter of the lecture, which occupies eighty pages, is divided into two sections; the first deals with the mode of formation and the nature of solid solutions, the second with the connection between the crystalline form and the constitution of pairs of substances which give rise to solid solutions. Explanatory notes, experimental data relating to the observations referred to in the first part of the text, and references to original papers which are in many cases accompanied by critical abstracts, occupy the remaining fifty pages. The arrangement is a most satisfactory one, and the many references afford an excellent bibliography of the subject.

Not more than ten years ago a solid solution was regarded as somewhat in the nature of a *rara avis*. The investigations of Roozeboom, Tammann, Kurnakow, Bruni, Carelli and others have, however, necessitated a complete change in the attitude of the chemist towards the conception. As showing the general character of the phenomenon, the fact may be cited that of one hundred and forty pairs of elements examined by Tammann and his pupils, no less than seventy-seven give rise to solid solutions, and in twenty-three cases mixed crystals are formed which contain the constituent elements in all possible proportions.

Most interesting is the author's account of the application of the observed facts relating to the formation of solid solutions to the determination of the configuration of organic compounds. That much valuable information may be obtained from observations on syn-morphism (ability to form mixed crystals) in connection with the solution of certain stereochemical problems is clearly indicated. It is, however, not only on account of its applications, but of the intrinsic interest which attaches to the phenomenon that Prof. Bruni's lucid exposition of the subject of solid solutions and isomorphism may be expected to meet with a favourable reception by a wide circle of readers. Not merely the chemist, but the physicist, mineralogist, and geologist will find much that bears on his particular subject in this little volume.

H. M. D.